

Test Procedure for Total Ionizing Dose Radiation Testing of Piece-Parts

Prepared by: James R. Coss
James R. Coss, Radiation Testing Group

Date: 7/10/98

Reviewed and
Approved by: Allan H. Johnston
Allan H. Johnston, Group Leader
Radiation Test Group

Date: 7/10/98

Reviewed and
Approved by: Charles E. Barnes
Charles E. Barnes, Group Supervisor
Radiation Test and Failure Analysis

Date: 7/10/98

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Parts Engineering Office (507)
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109

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1.0 SCOPE

This procedure covers total ionizing dose radiation testing of piece-parts. The requirements are given herein for the test procedure and sequence; in addition, parts handling and data recording are also defined.

2.0 DEFINITIONS

Definitions of terms used in this procedure are given in this section:

Device or piece-part - A single item of a given part type.

Control unit - A device from the lot to be tested that is not subjected to the radiation environment. The function of this device is to verify the consistency of the measurement data.

HDRF – High Dose Rate Radiation Facility

LDRF – Low Dose Rate Radiation Facility

Lot Acceptance Testing (LAT) - Radiation testing for a piece-part sample from a particular manufacturer's date code, diffusion run, or wafer.

Post-irradiation effects (PIE) – Post-irradiation evaluation of annealing effects versus time at a specific temperature.

Radiation test requirements - Requirements to perform a specific radiation test of a manufacturer's (Mfg.) device type, as agreed to with the customer.

3.0 TEST DOCUMENTATION

3.1 Radiation Test Traveler and Sign Off Sheet (Traveler)

A Radiation Test Traveler and Sign Off Sheet (Figure 1) will accompany each group of devices to be tested. The purpose of the traveler is to provide a record of the irradiation.

3.2 Radiation Test Log

Each lot of piece-parts to be tested is logged in and assigned a unique log number for later tracking. The log is maintained both by computer and in a hard copy log stored in Bldg. 300, Rm. 119. Each device will be given a unique serial number.

4.0 TEST SAMPLES

Test samples are either evaluation samples or samples taken from a flight lot. All device types are to be treated as "charge sensitive", requiring special handling to protect against static electrical discharge. At least five test samples and one Control Unit are recommended for each test.

Electrical tests before irradiation will verify that the test samples are within customer specifications. A device out of applicable specification limits will be tested only after the discrepancy has been resolved with the customer.

5.0 FACILITIES

Three JPL ionizing radiation facilities are available for testing: a) Bldg. 300 HDRF Cobalt 60 source and b) two LDRF Co60 sources in Bldg. 277, only one of which is currently in use. These facilities can only be used by a certified operator, following the HDRF and LDRF procedures and safety requirements.

The test device circuit board will be placed at a distance from the irradiator throat to receive the dose rate specified in the radiation test requirements. The total dose level can be measured with an ionization chamber or calculated from a previous field calibration by facility personnel.

6.0 RADIATION DOSIMETRY

Radiation dosimetry at the Cobalt 60 source will be performed periodically using an ion chamber with accuracy traceable to the US Bureau of Standards. When required, beam uniformity measurements may be made over the test board to show that the total doses and dose rates on the devices under test do not vary more than $\pm 10\%$ at different positions on the test board.

7.0 TEST EQUIPMENT

Electrical test equipment, including power supplies, digital voltmeters, microammeters, etc., is used to measure electrical parameters before and after each irradiation step. The test equipment list may include special automated test equipment. Use of this equipment is not addressed in this procedure.

8.0 CONTROL UNITS

A device from each test lot will be used as a Control Unit. The Control Unit will be measured before each set of post-irradiation parametric measurements, but not exposed to the radiation. The purpose of the Control Unit is to verify the stability of the measuring equipment.

9.0 TEST PROCEDURE

This test procedure is a general plan and it is anticipated that minor deviations will occasionally be necessary.

9.1 Radiation Test Requirements

Electrical parameter tests, dose rates and total dose levels will be agreed to between radiation test personnel and the customer prior to initiation of testing.

9.2 Test Fixtures and Equipment

The test setup will be assembled, the necessary test equipment obtained and checked out to insure proper operation. After suitability of the test setup has been established, the test device electrical parameters will be measured on the radiation test system in the laboratory.

9.3 "Brown Box"

All radiations will be carried out in a Pb/Al "brown box". This box will have a minimum of 1.5 mm of Pb, surrounding an inner layer of 0.7-2.0 mm of Al. Because the box attenuates gamma rays, the gamma ray intensity will be calibrated to account for the attenuation.

9.4 Research Testing

Research testing by its very nature prohibits following predetermined rigid test requirements such as specified herein. For example, requirements may be revised during and after testing and standard data reduction methods may not be appropriate. Although deviations from this document may be required for research testing, the

requirements of this test procedure will be followed as closely as practicable.

9.4 Post Irradiation Effects (PIE) Testing

Because electrical parameter degradation of some devices has a time dependency, parametric measurements will be performed at various time intervals after irradiation. These parameter shifts may lead to device failure at long (1 hr to 30+ days) times after the end of irradiation. To determine if any effect occurs, long-term post-irradiation electrical measurements must be made. For most devices, the short-term measurements (1 hr to 10 days) will show the most change. Tests should be scheduled to allow measurements to be made during normal working hours and, when practicable, include 1, 3 and 7-hour measurements in the same day. Early measurements may be omitted if it is determined that no significant effects are occurring.

10.0 DATA REQUIREMENTS

It is extremely important that all identifying numbers that can be determined from the device package and accompanying paper work be recorded on the data sheets to fully identify each device tested.

10.1 Data Recording

The following data must be recorded during the test:

1. Part number, manufacturer and date code
2. Bias conditions during irradiation
3. Dose rate
4. Total dose at each radiation step
5. Bias conditions during electrical testing
6. Parametric measurements after each radiation step.

RADIATION TEST TRAVELER AND SIGN-OFF SHEET

Device Type: _____ Test ID No: _____

S/Ns: _____

Mfr.: _____

Log-in Date: _____

Pkg. Type: _____

Lot No: _____ Lot Accept. (check) _____

Other ID Nos.: _____

Wafer No.: _____

Test Type: _____

Date Code: _____

Quantity: _____

Tester Type: _____

Control Unit Type: _____

Tester Name: _____

Control Unit No: _____

Other Controls: _____

Sign Off List for Requirements and Test Steps	Initial	Date
1) Parts received for testing and logged in		
2) New/revised radiation test requirements developed or old requirements verified		
3) Bias circuit built and checked		
4) Coordinate Test Data Formatting and Handling		
5) Bias Circuit Designed and Checked		
6) Test carried out per requirements		
7) PIE measurements taken per requirements (if applicable)		
8) Parts returned to storage and test data to JPL		

Comments:

Figure 1
Radiation Traveler and Sign-off Sheet